# Small scale fluctuations in lidar observations of a noctilucent cloud

N. Kaifler, B. Kaifler, M. Rapp

Institute of Atmospheric Physics
Oberpfaffenhofen
German Aerospace Center

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La Reunion


DLR

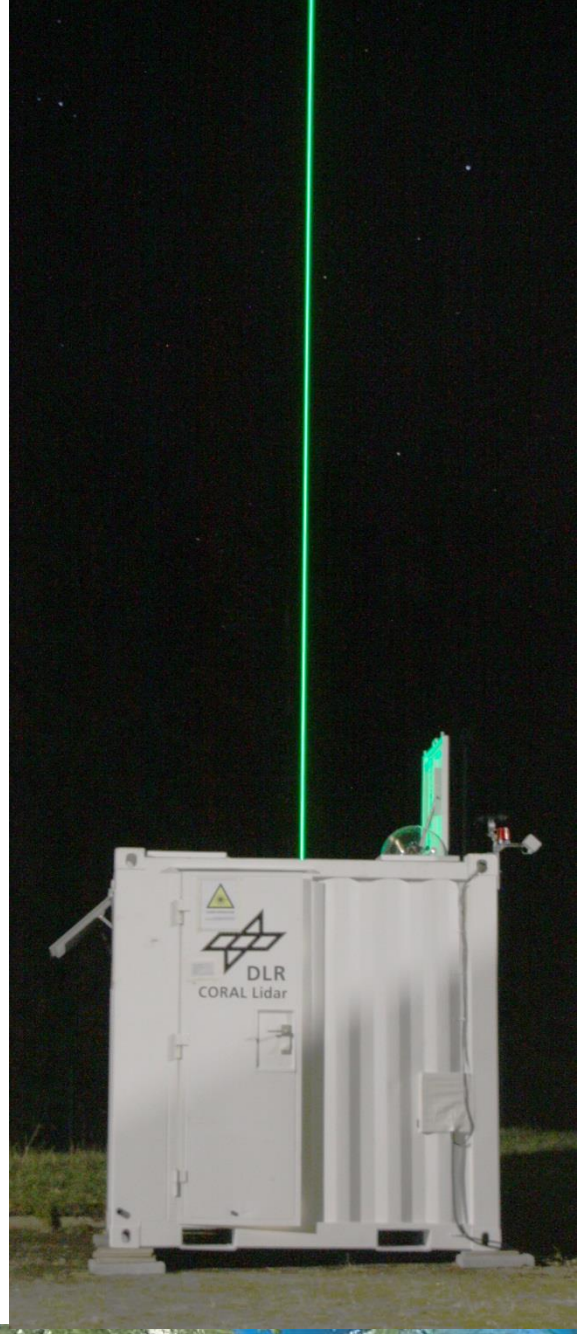
# CORAL lidar

Instrument

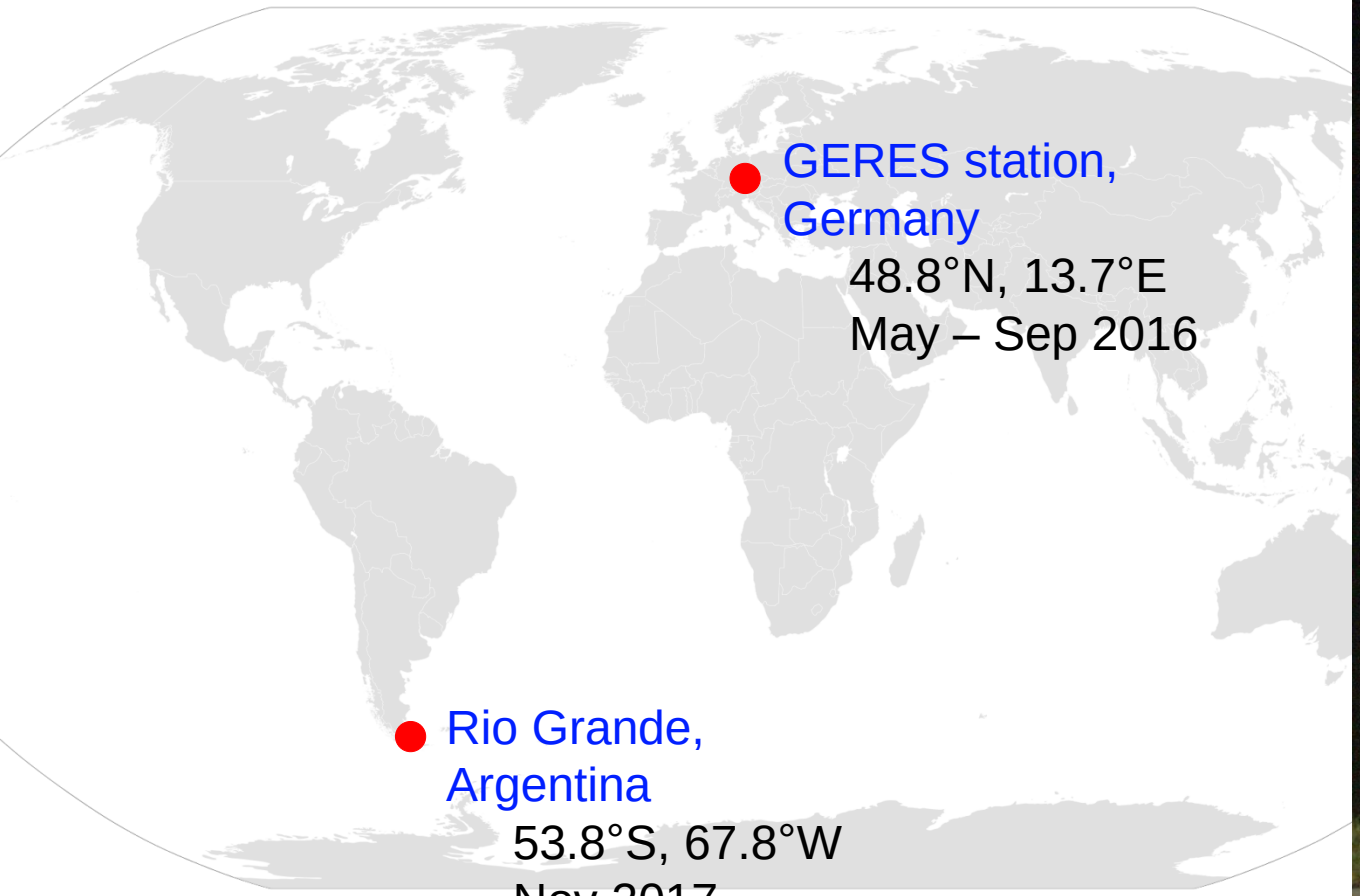
- Compact, autonomous Rayleigh lidar
- Nd:YAG, 12 W, 532 nm
- 61 cm receiving telescope
- 100 Hz
- 2 channels (4 channels)

Data products

- Atmospheric density, temperature, gravity waves and aerosol backscatter
- 30-90 km altitude
- 900 m vertical resolution
- 10 min temporal resolution

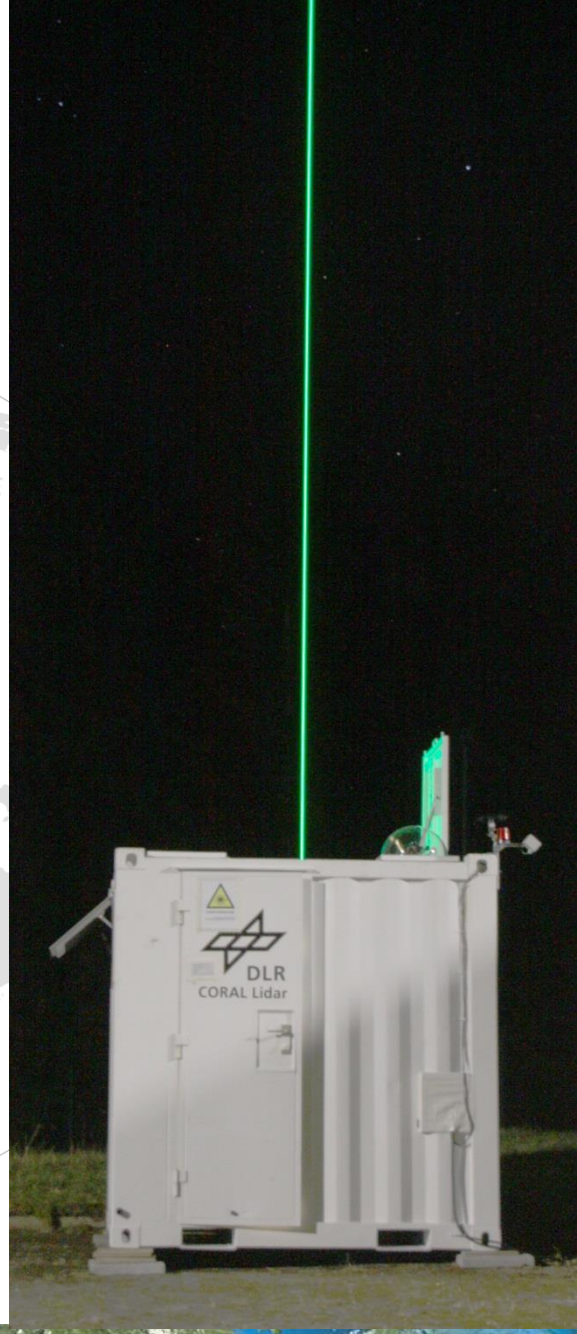



# CORAL within ARISE



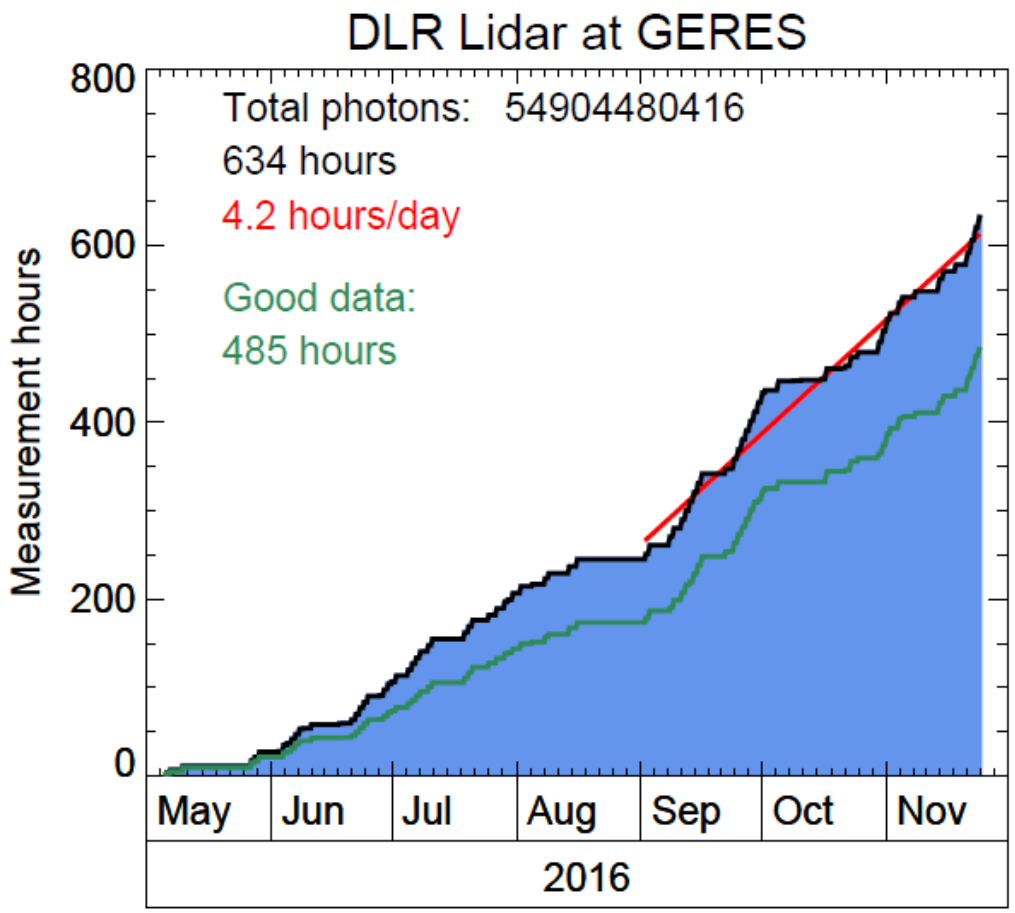
GERES station, Germany
48.8°N, 13.7°E
May – Sep 2016

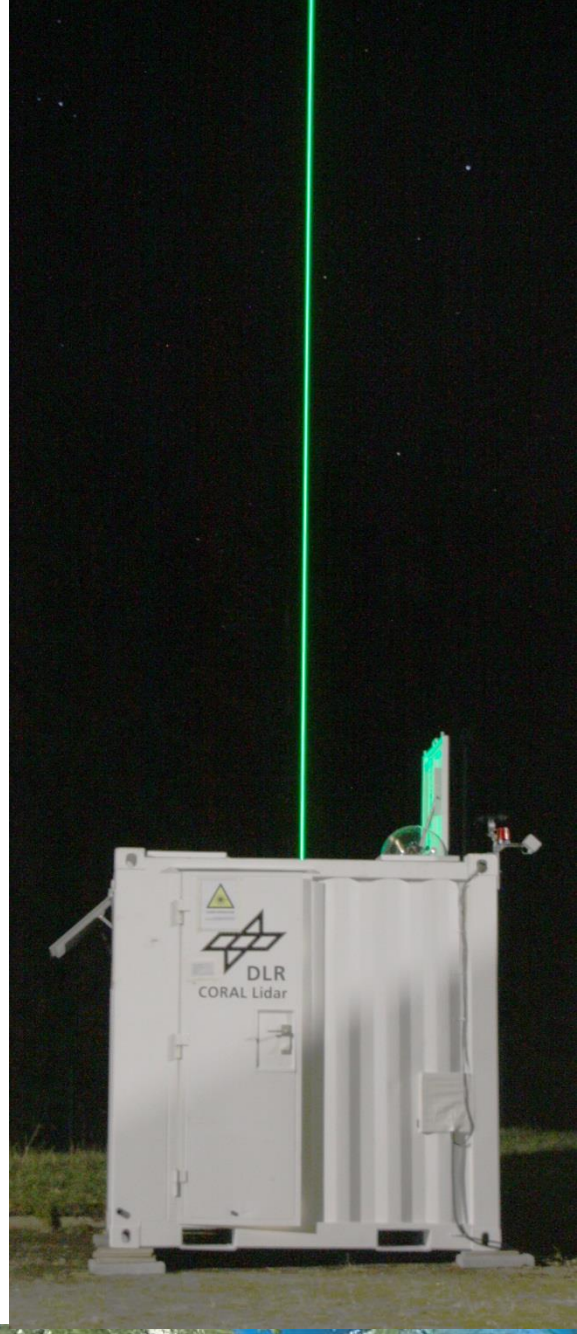
Rio Grande, Argentina
53.8°S, 67.8°W
Nov 2017 -



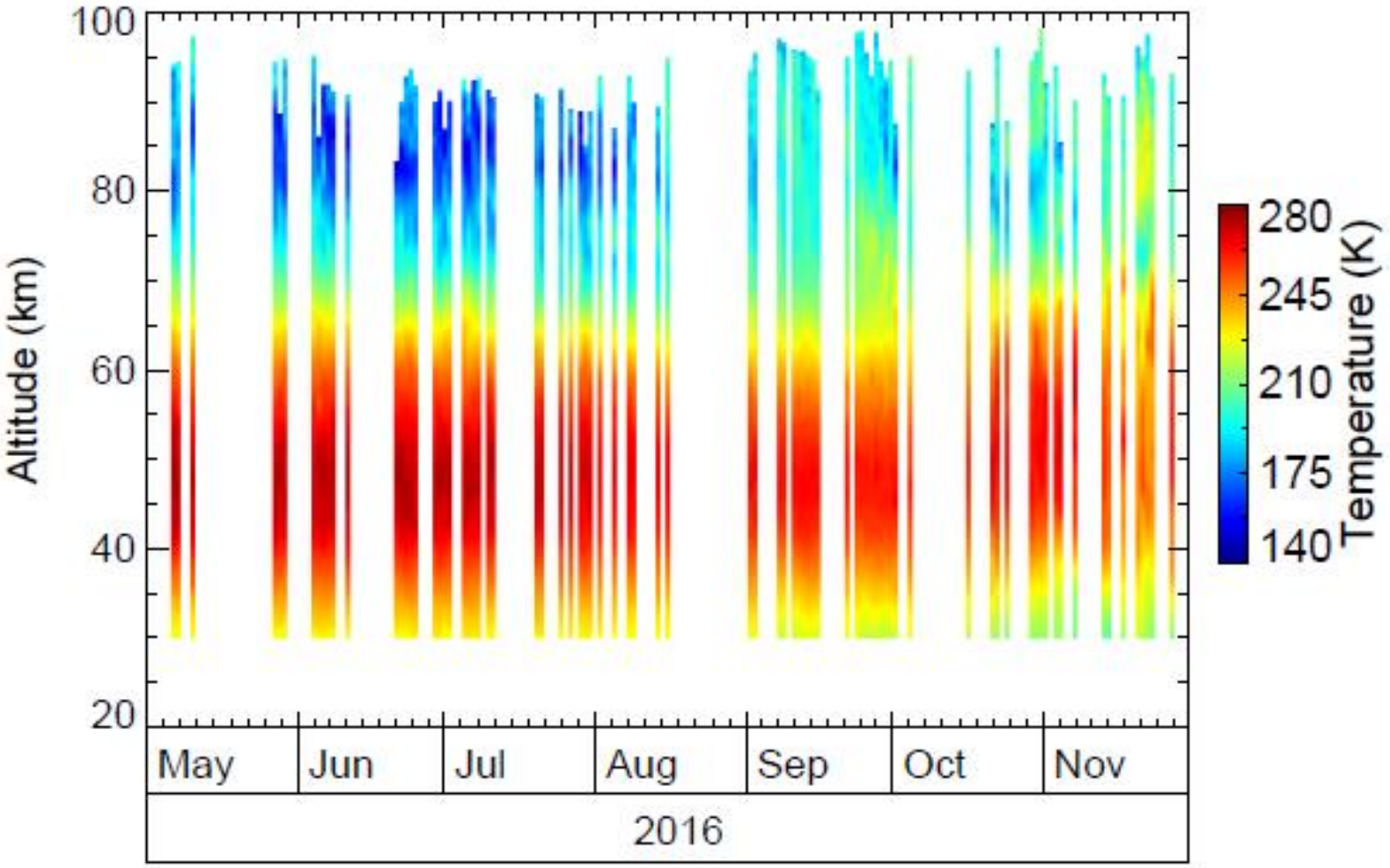

DLR

# Measurement statistics

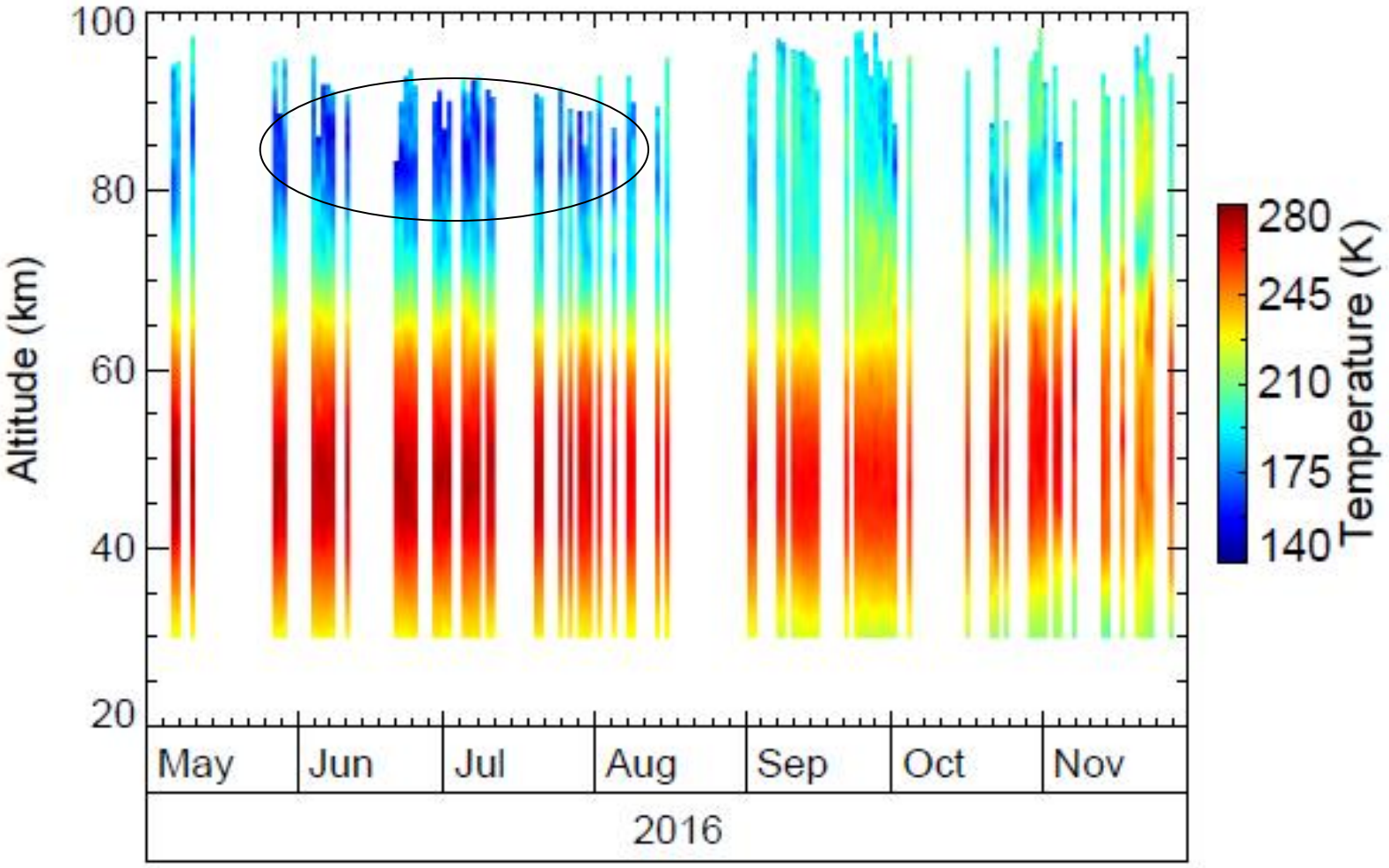


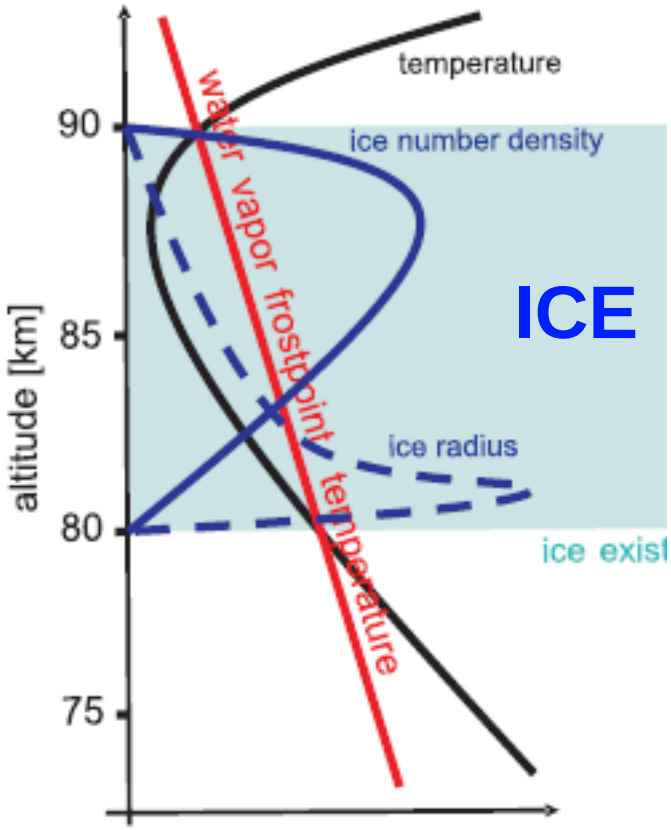

# Atmospheric temperature




# The cold summer mesopause

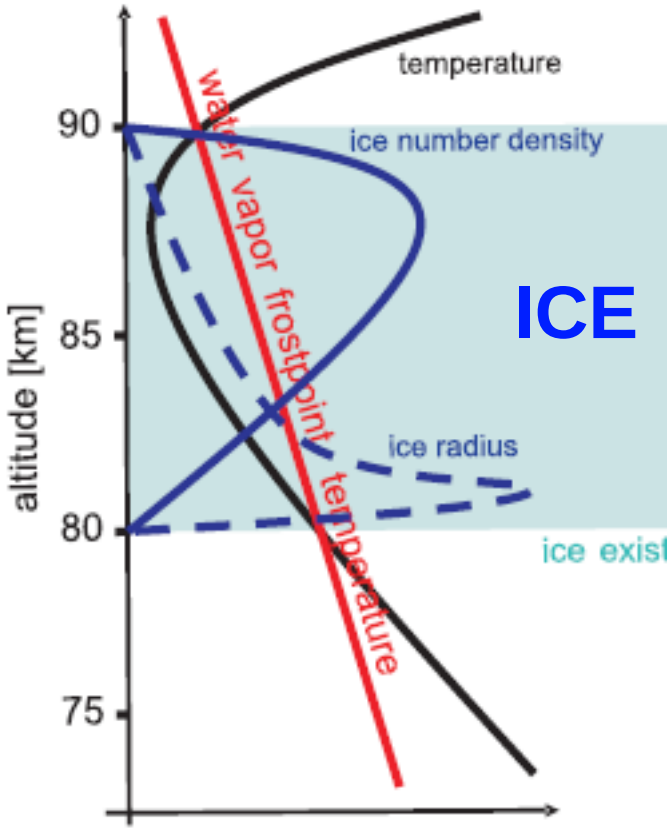



# Ice formation

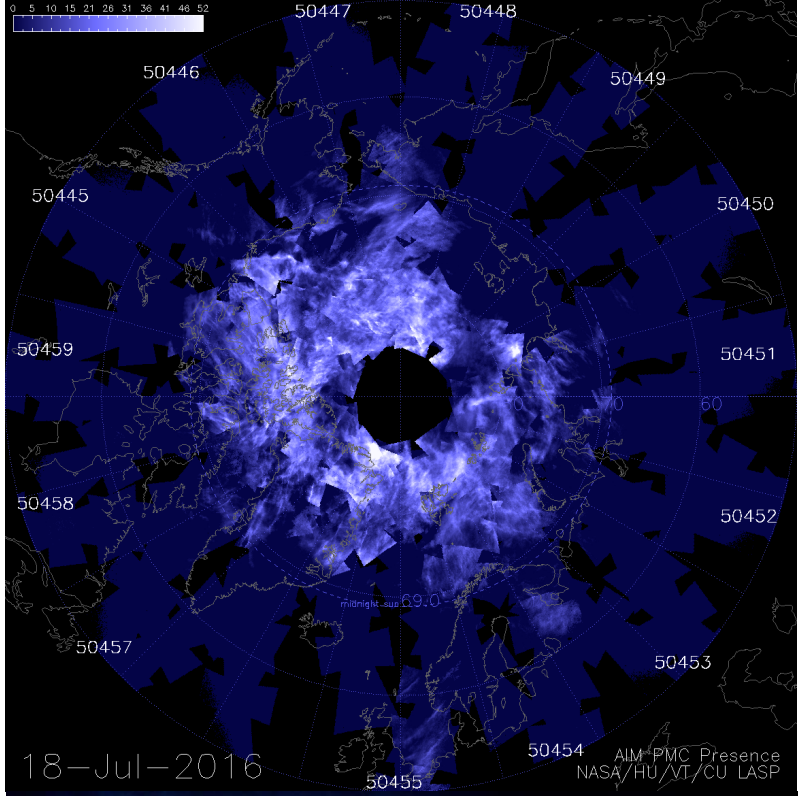



Rapp and Thomas, 2006

# Noctilucent clouds



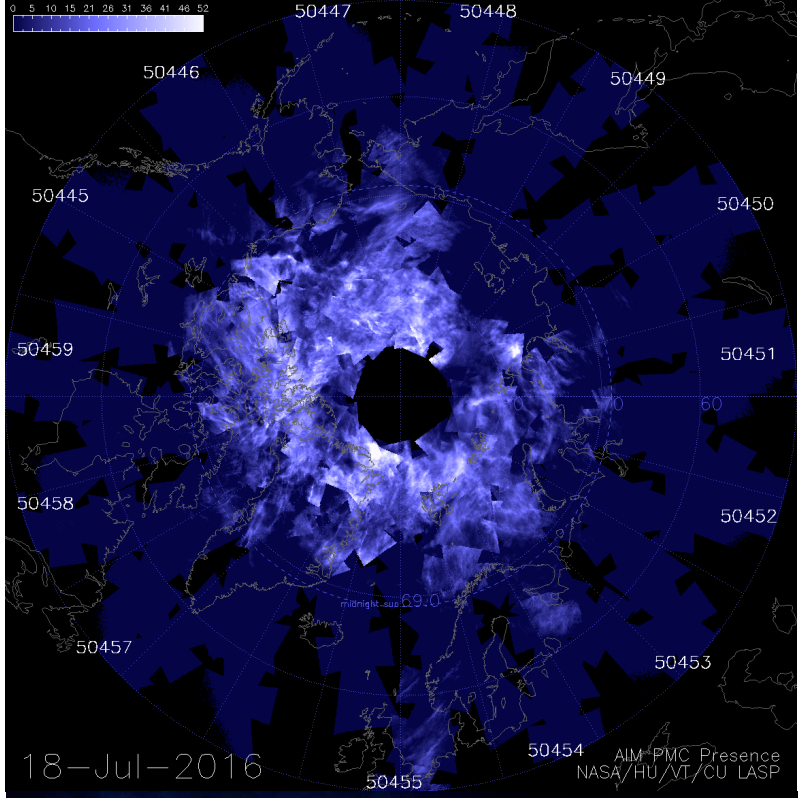

Rapp and Thomas, 2006




# Noctilucent clouds

- Incredibly strong Mie backscatter
- Sensitive indicator for temperature and water vapour

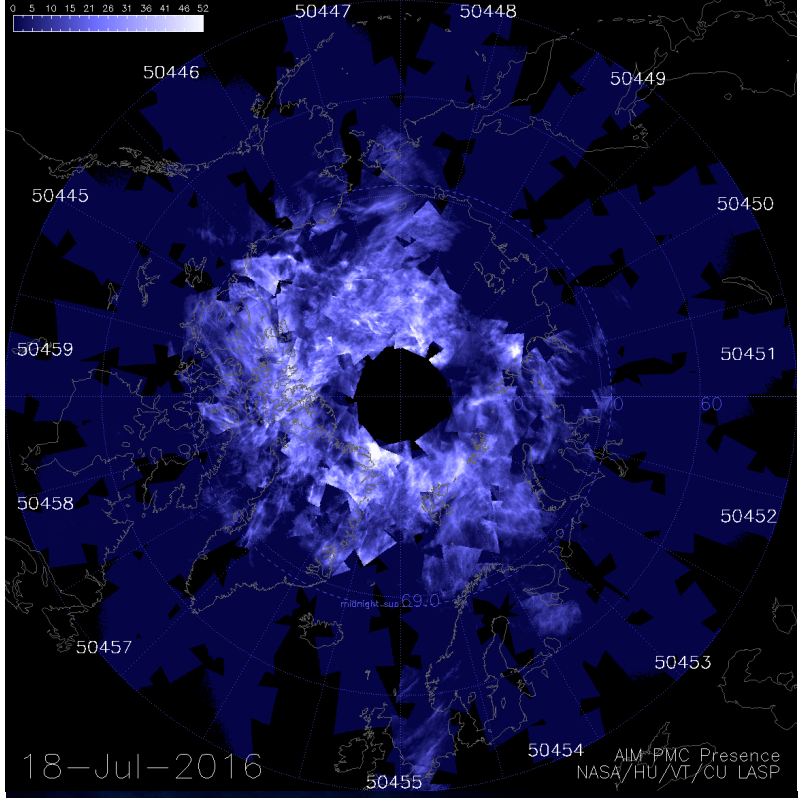
| Climate change | | Gravity waves | | Turbulence |
|---|---|---|---|---|
| century | | | | seconds |
| global | | | | Meters, centimeters |



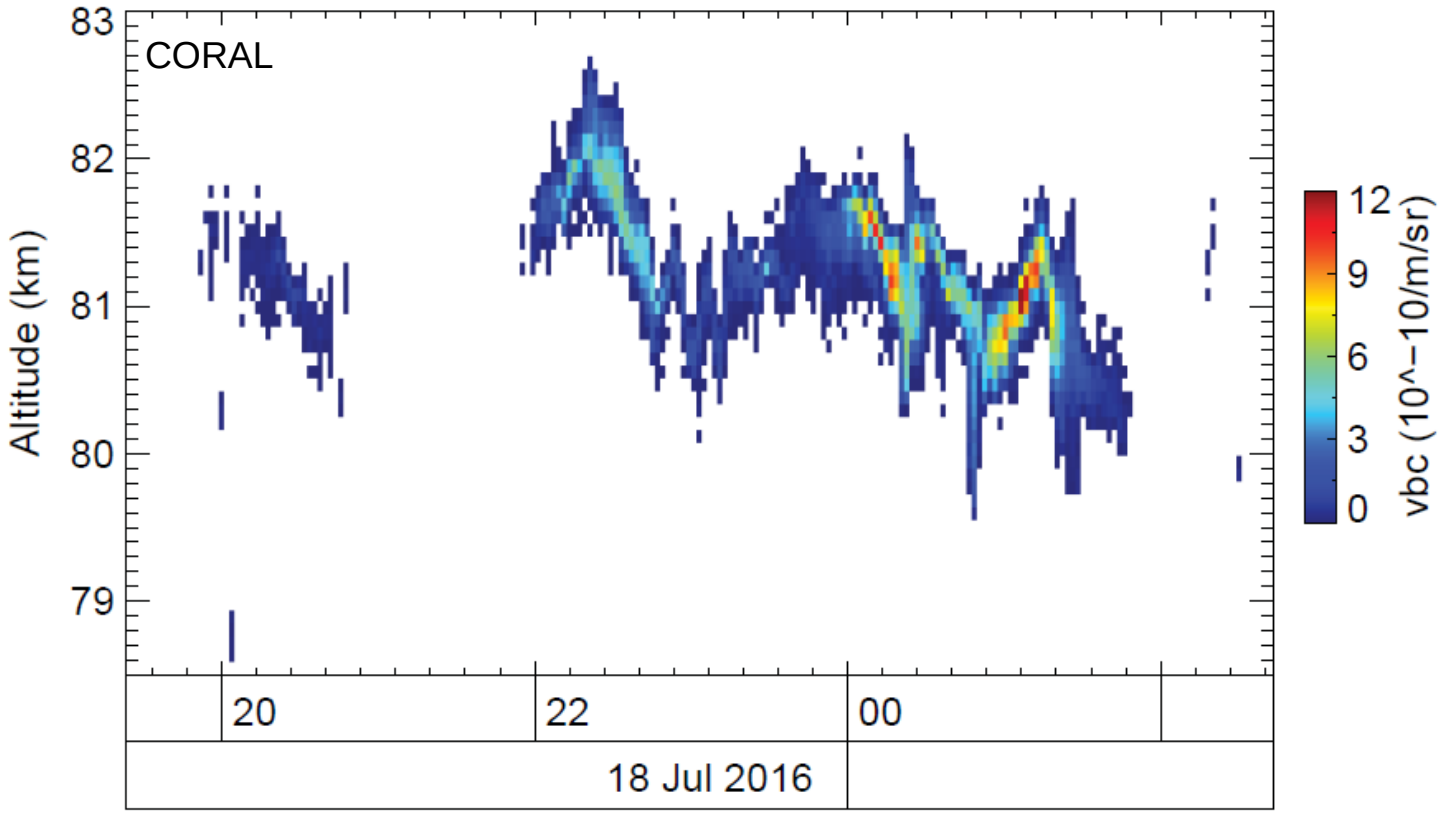

# Noctilucent clouds

- Incredibly strong Mie backscatter
- Sensitive indicator for temperature and water vapour

| Climate change | | Gravity waves | | Turbulence |
|---|---|---|---|---|
| century | | Hours, minutes | | seconds |
| global | | 1000 km to 10 km | | Meters, centimeters |




# Only NLC observation of 2016 season at 48.8°N

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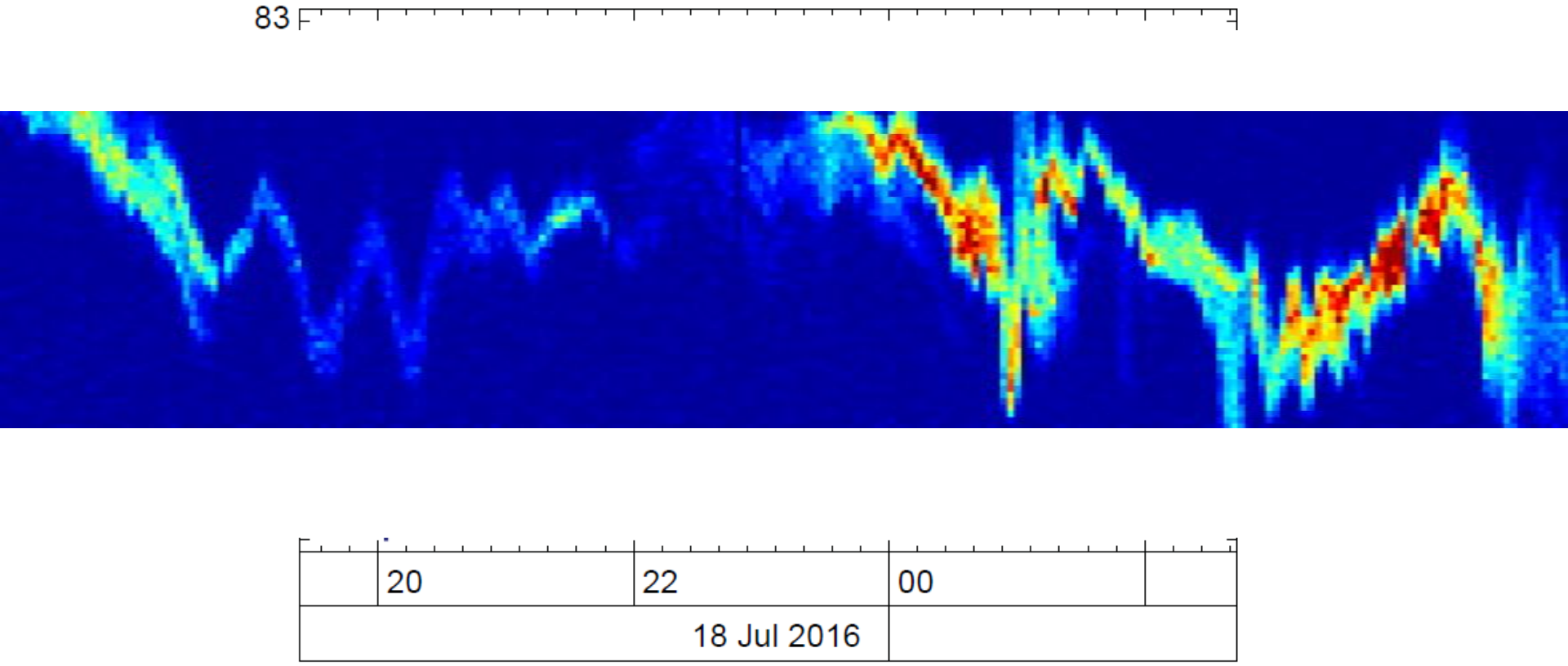
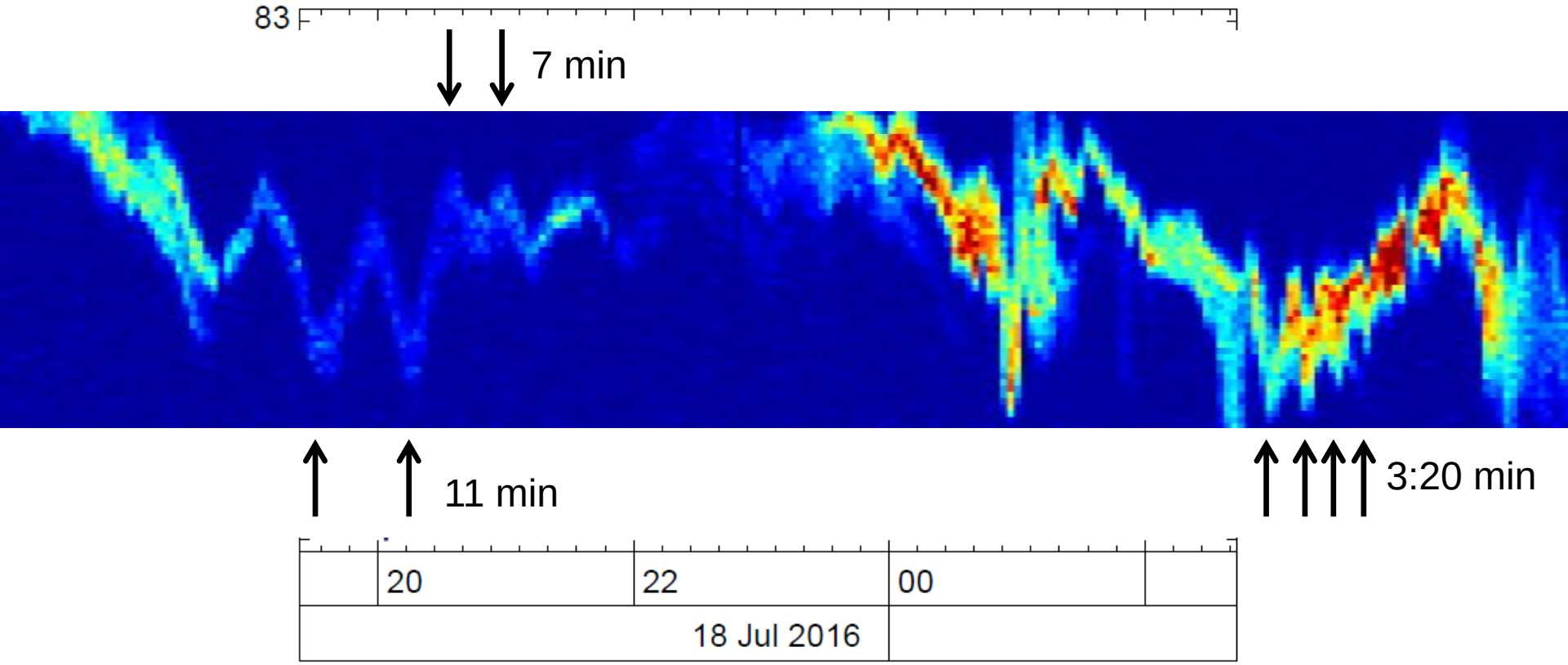
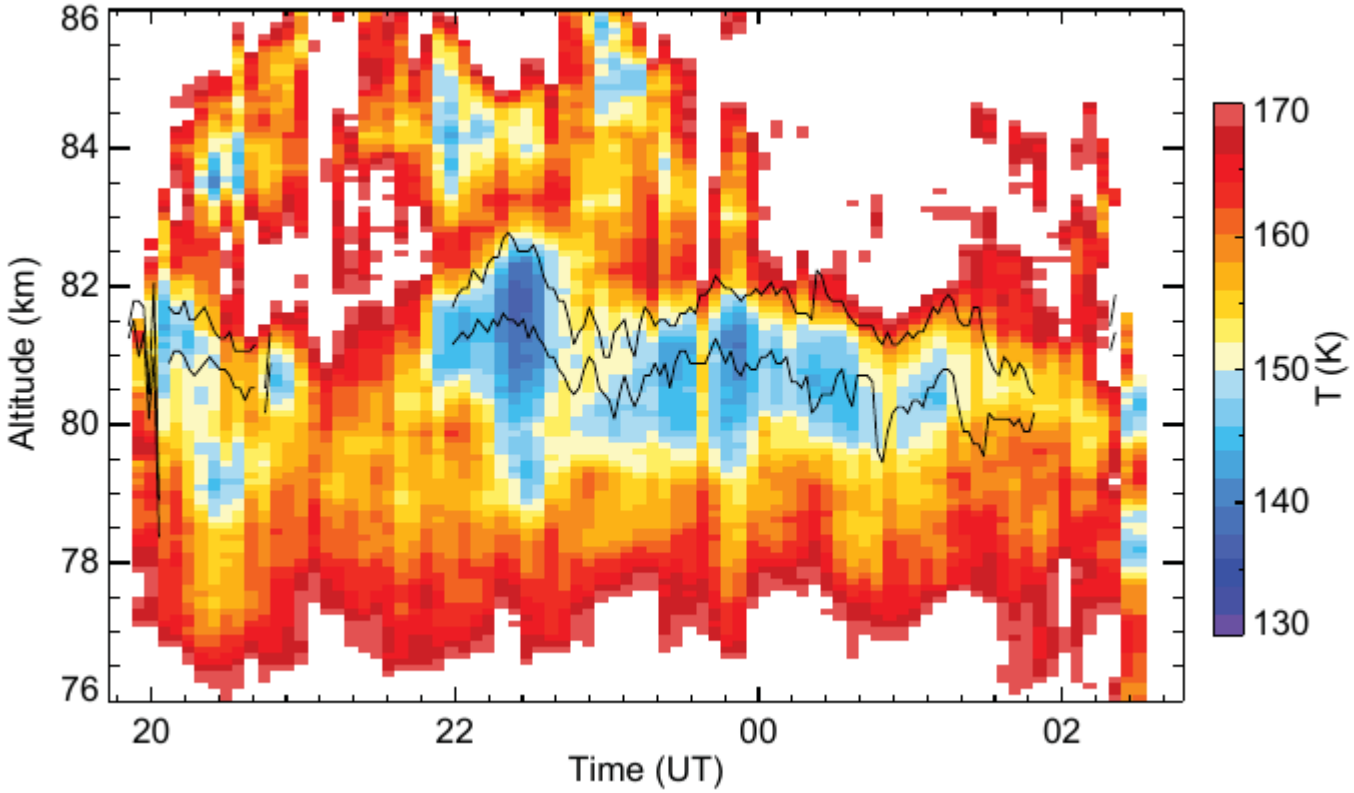



# Small scale structures in thin-layered NLC



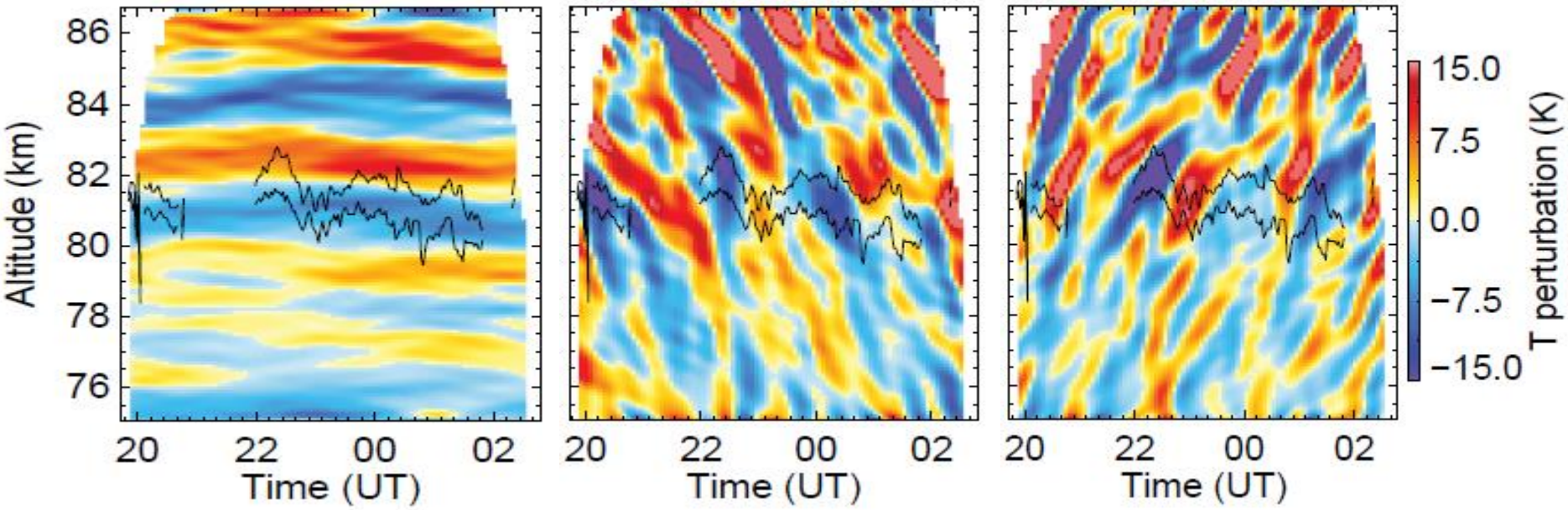

- Rich small scale structure

# Temperature in vicinity of NLC layer (black contour)



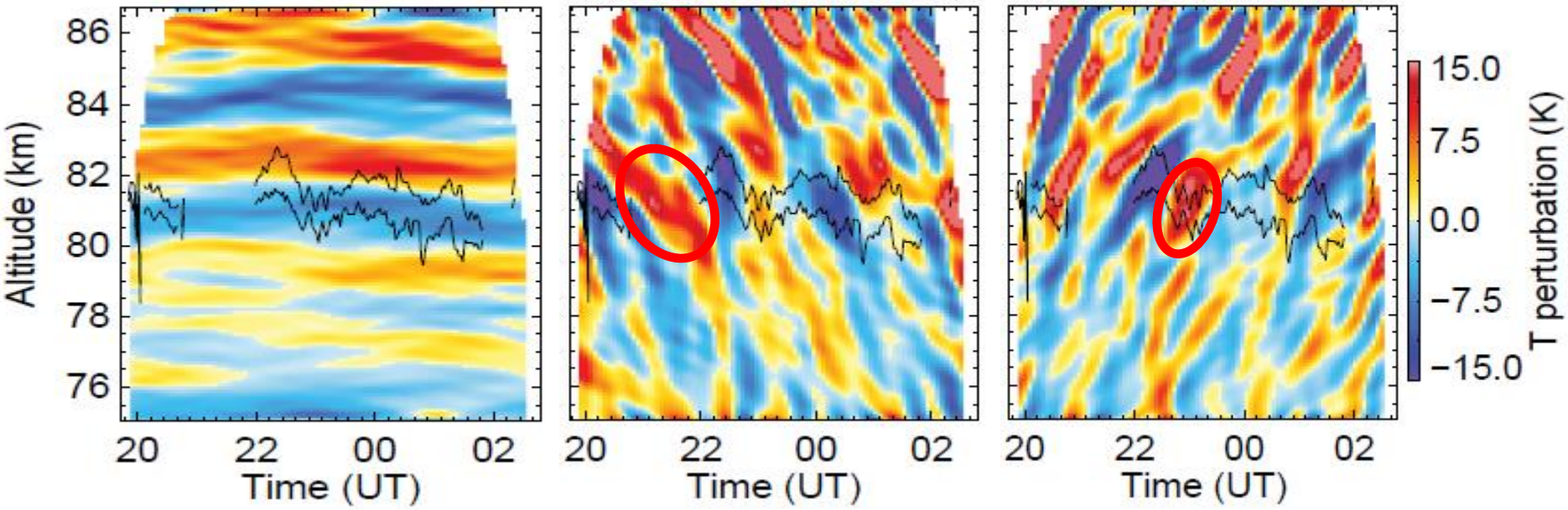

- Low latitude: lidar sounding in darkness
- Rayleigh temperatures above NLC layer

# Gravity waves and noctilucent clouds



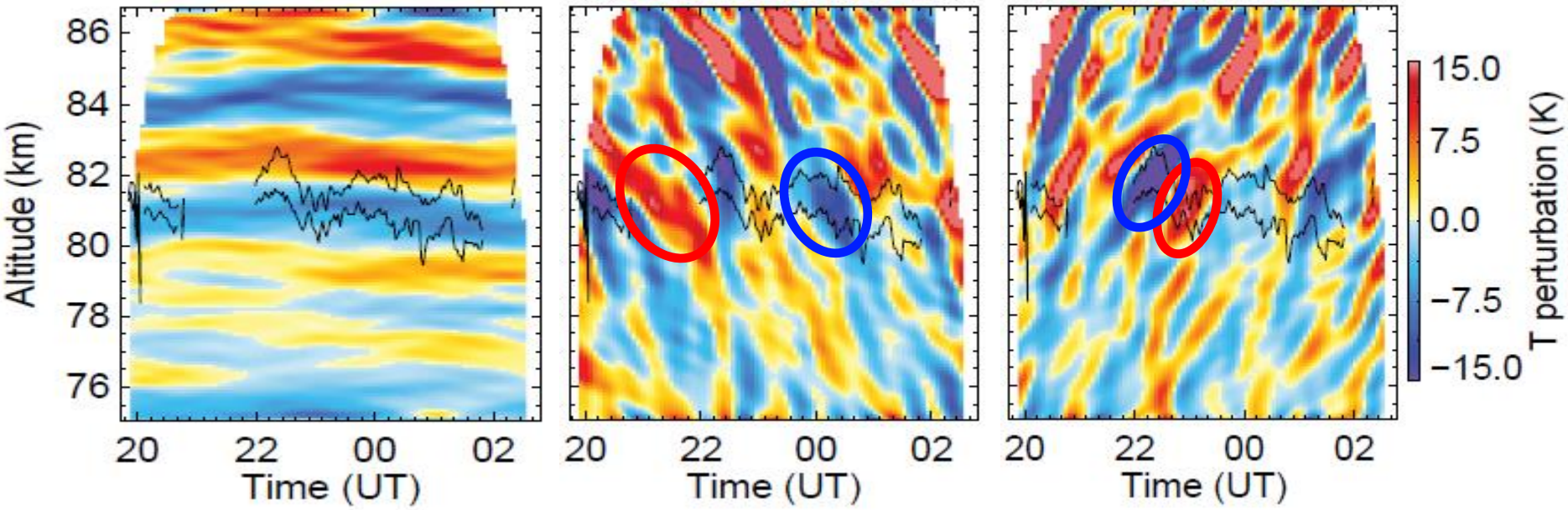

- Spectrally filtered temperature perturbations reveal gravity waves
- NLC within cold phases of gravity waves

# Gravity waves and noctilucent clouds




- Warm phases
- Low or vanishing NLC brightness

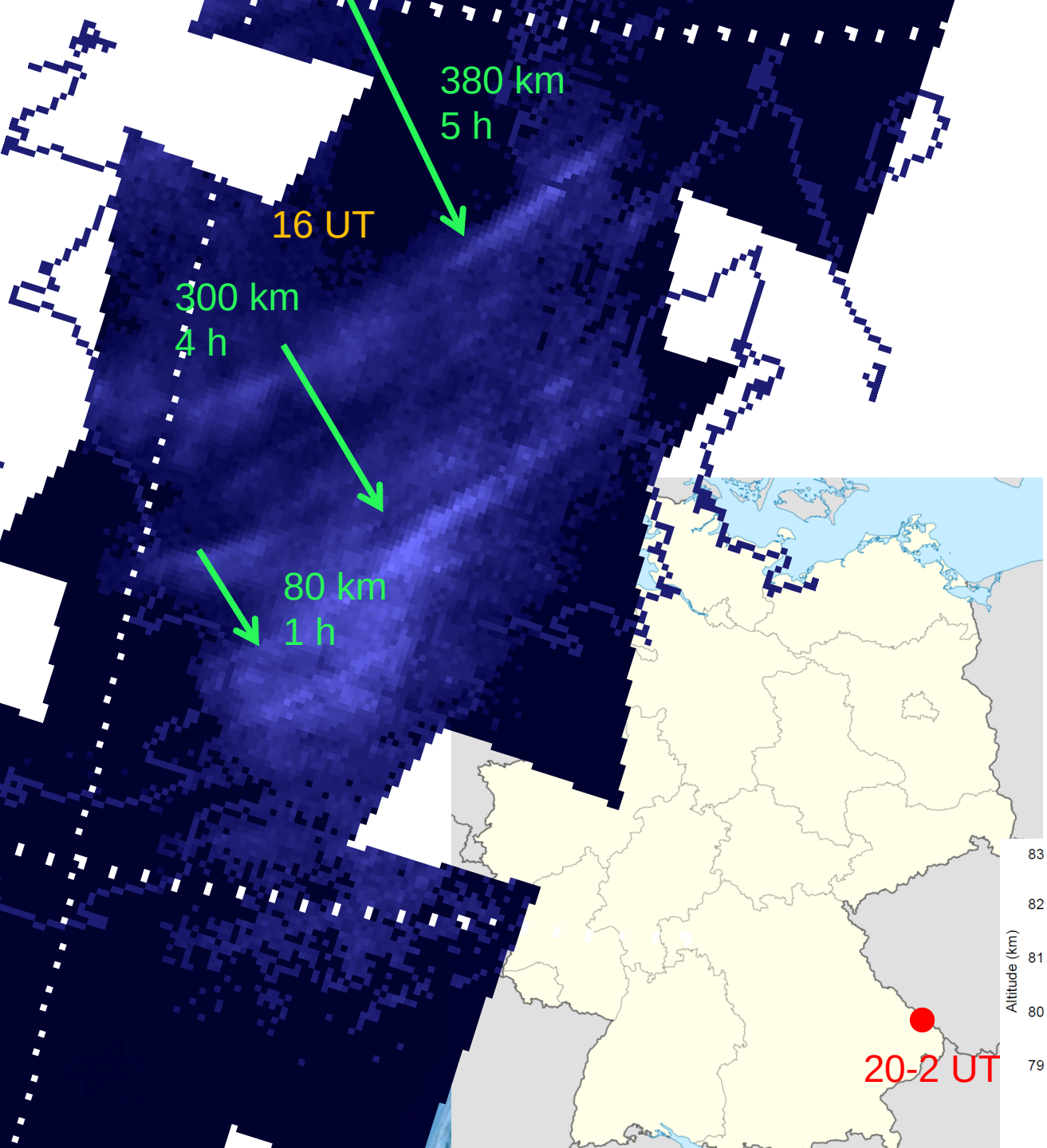
# Gravity waves and noctilucent clouds

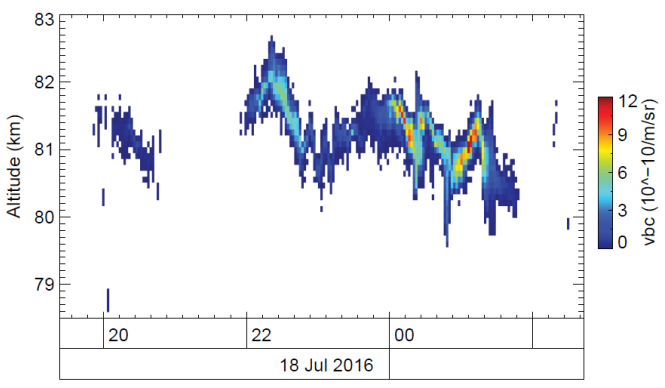


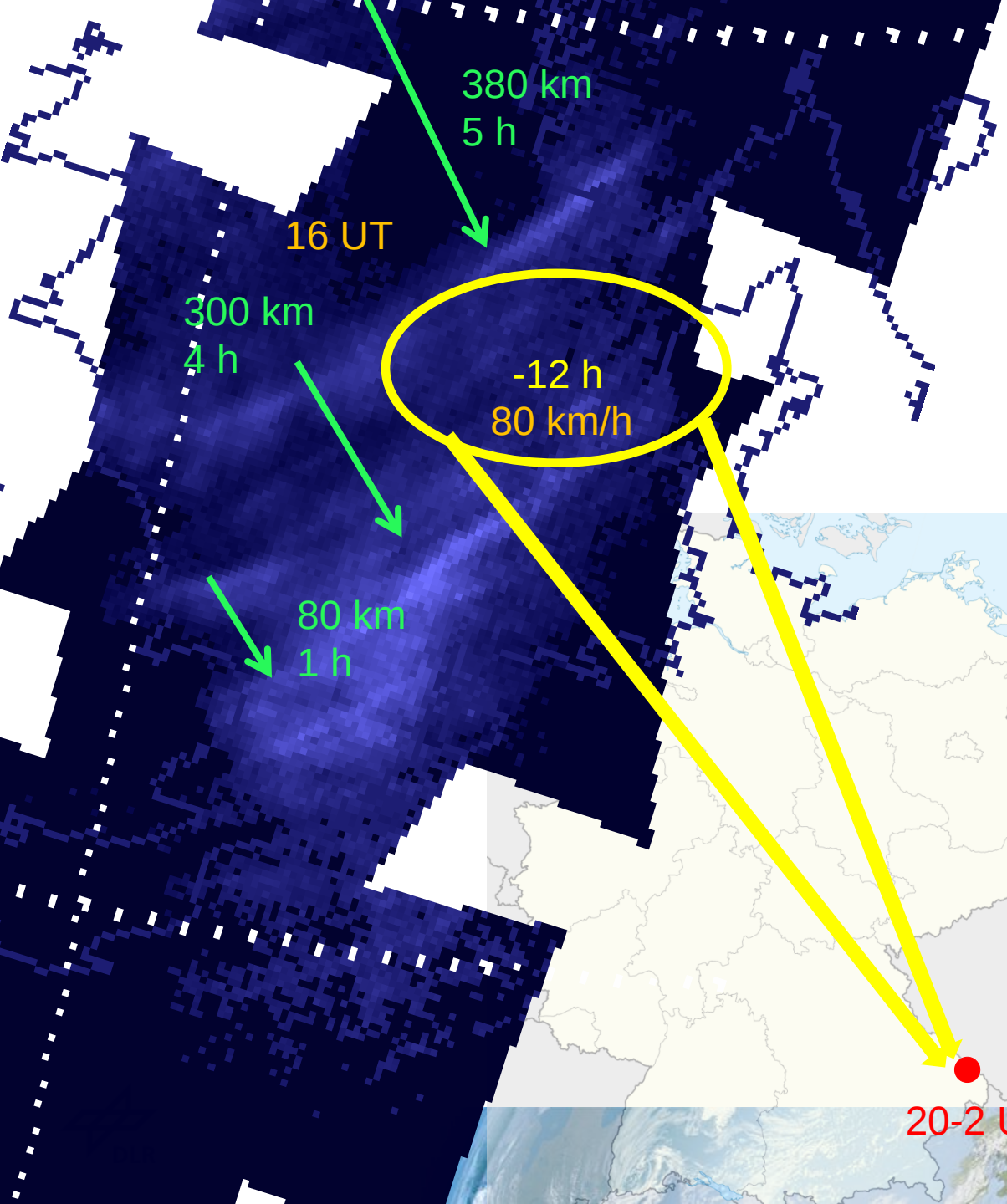

- Cold phases
- Particle growth

# Spatial extent

- Extended field of NLC 52 – 62°N above North Sea
- Aligned wave crests
- 80, 300 and 380 km

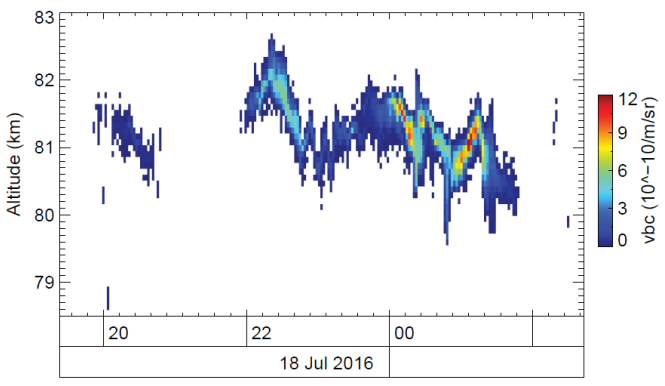





# 18/19 Jul 2016

- Matching meteor wind measurements



# 18/19 Jul 2016

380 km
5 h

16 UT

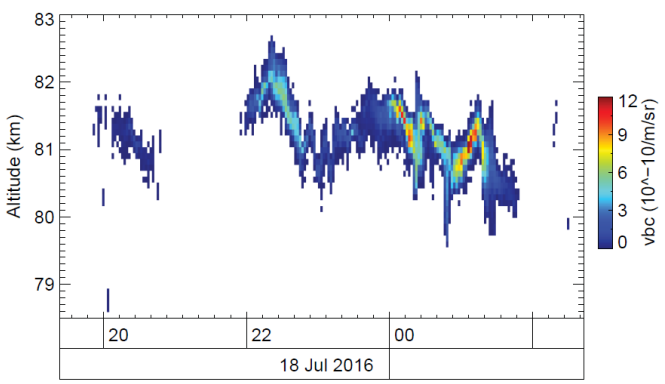
300 km
4 h

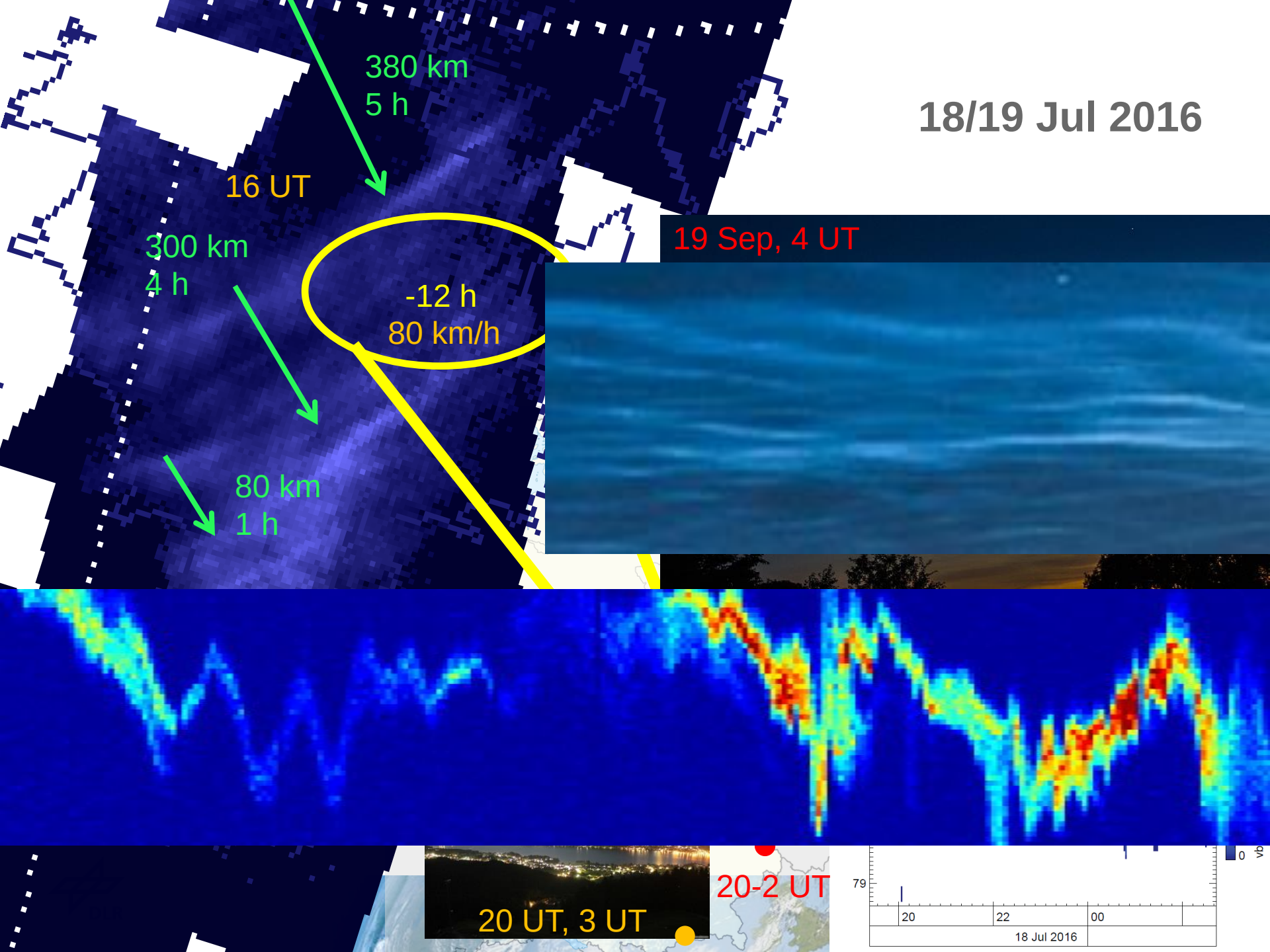
-12 h
80 km/h

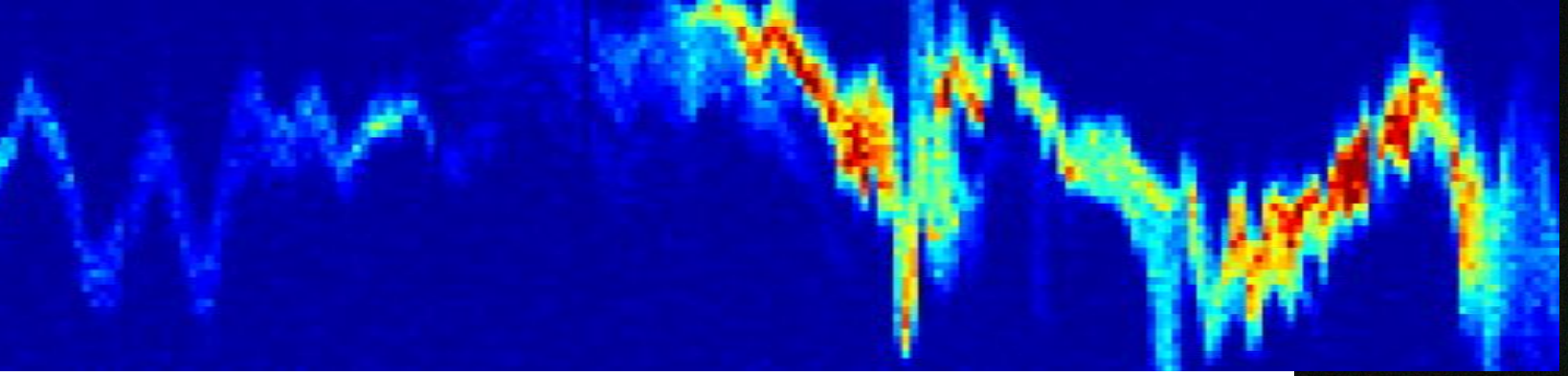
80 km
1 h



20-2 UT




18/19 Jul 2016
380 km
5 h
16 UT
300 km
4 h
-12 h
80 km/h
80 km
1 h
19 Sep, 4 UT
20 UT, 3 UT
20-2 UT
79
20
22
00
18 Jul 2016
0



## Summary

- Lidar measures NLC backscatter, temperature and gravity waves
- Noctilucent clouds are like a microscope
- Detection of small scale structures at mesopause altitude
- Presentation of the record 2016 event at this latitude
- Any SH lidar observations of NLC to come?


# Mesopause winds

- Meteor radar from Collm and Kühlungsborn
- Strong 2-day planetary wave
- Strong southward wind on 18/19 July 2016 at 82 km
- 22 m/s  or 80 km/h

→Transport of cold air from polar to mid-latitudes